

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Currently Amended) An end effector adapted to grip a peripheral edge of a workpiece, comprising:

a workpiece blade for supporting a workpiece;

a first gripper arm and a second gripper arm each operatively mounted to said workpiece blade, said first and second gripper arms each including a contact pad;

means for moving said first and second gripper arms between a workpiece-loading position and a workpiece-engaging position said contact pads contacting the peripheral edge of the workpiece and exerting a force on the workpiece when said first and second gripper arms are located in said workpiece-engaging position; and

a real-time force feedback system means for dynamically adjusting the force exerted by the first and second gripper arms on the workpiece while after said first and second gripper arms are located in said workpiece-engaging position.

2. (Previously Cancelled)

3. (Original) The end effector according to claim 1, wherein said first and second gripper arms further include a force sensing device adapted to measure the force said contact pads exert on the workpiece.

4. (Original) The end effector according to claim 1, wherein said contact pads further include sensors adapted to detect the edge of the workpiece.

5. (Original) The end effector according to claim 4, wherein said sensors comprise thru-beam sensors.

6. (Original) The end effector according to claim 1, wherein said means for moving said first and second gripper arms comprises a motor assembly that is operatively coupled with said first and second gripper arms.

7. (Original) The end effector according to claim 6, wherein said motor assembly includes:
- a brushless motor having an output shaft;
 - a planetary gear having a first end coupled to said output shaft and a second end having a shaft extending outward from said planetary gear that rotates slower than said output shaft;
 - a cam coupled to said shaft, said cam having a geometrical center that is offset from the rotational center of said shaft;
 - a carriage having a drive slot adapted to receive said cam; and
 - a flexible link having a central portion adapted to secure to said carriage, a first end adapted to secure to said first gripper arm, and a second end adapted to secure to said second gripper arm.

8. (Original) The end effector according to claim 7, further comprising a real-time force feedback system, including:

- a force sensing device secured to each one of said contact pads, each force sensing device adapted to generate an electrical signal representing the amount of force being exerted against the workpiece; and

- a processor adapted to receive said electrical signal from each said force sensing device and sending an electrical signal to said brushless motor in order to adjust the position of said first and second gripper arms.

9-16. (Cancel)

17. (Previously Amended) An apparatus for handling wafers, comprising:

- a wafer blade for supporting a wafer;
- a first contact arm and a second contact arm each operatively mounted to said wafer blade, said first and second contact arms each having a contact pad adapted to contact a peripheral edge of the wafer;
- a motor assembly operatively connected to said first and second contact arms, said motor assembly for moving said first and second contact arms between a wafer-loading position that allows a wafer to be loaded onto said wafer blade and a wafer-engaging position where each said

contact pad contacts the peripheral edge of the wafer and exerts a force on the wafer;
a force sensing device for measuring the amount of force each said contact pad exerts against the peripheral edge of the wafer; and
a force feedback system electrically coupled to said force sensing device and said motor assembly, said force feedback system controlling the operation of said motor assembly based at least in part on the amount of force measured by said force sensing device.

18. (Original) The apparatus according to claim 17, wherein said force sensing device measures the force said contact pads exert on the wafer in real-time.

19. (Previously Amended) The apparatus according to claim 17, wherein each said contact pad further includes sensors adapted to detect the edge of the wafer.

20. (Original) The apparatus according to claim 17, wherein said force sensing device comprises a load cell.

21. (Original) The apparatus according to claim 17, wherein said force sensing device comprises a strain gauge.

22-23. (Cancel)

24-26. (Previously Cancelled)

27. (Cancel)

28-32. (Previously Cancelled)

33-35. (Cancel)